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EXAMINER	
CHEN, JACK S J	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 10/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/935,255	WEIMER, RONALD A.	
	Examiner	Art Unit	
	Jack Chen	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 August 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-57 and 73-121* is/are pending in the application.

4a) Of the above claim(s) *15,22-57,73-96,101,102,107-111 and 113-121* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14,16-21,97-100,103-106 and 112* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/9/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/21/06 has been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-14, 16-21, 97-100, 103-106 and 112 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Re claims 1, 7, 8, 9, 16, 17, 18, 19 and 20, the term "continuous" is not described/supported by the original specification [There is nothing in the specification that discloses the silicon layer is "continuous"; it should be noted that the specification only has the support for forming a thin layer of silicon; and there is nothing drawings that requires this layer to be continuous].

Re claims 1, 5, 7, 8, 9, 16, 17, 18, 19 and 20, the phrase "about 10 to less than about 30 angstroms" is not described/supported by the original specification (i.e., the claimed range is not disclosed).

Re claim 5, the term "uniform" is not described/supported by the original specification [There is nothing in the specification or drawing discloses that the silicon layer is "uniform" and the drawings are not drawn to scale].

The remaining claims are rejected for depending from the above rejected claims.

For the purpose of patentability, these claims will be interpreted as best understood.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 99-100 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Re claims 99 and 100, the phrase "the silicon gas" lacks antecedent basis.

Claim status

1) Claims canceled: 58-72

2) Claims pending: 1-57, 73-121

3) Claims withdrawn from further consideration: 15, 22-57, 73-96, 101, 102, 107-111 and 113-121

4) **Claims Active: 1-14, 16-21, 97-100, 103-106, 112**

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims **1-14, 16-21, 97-100, 103-106, 112 are** rejected under 35 U.S.C. 103(a) as being unpatentable over Muralidhar et al., U.S./6,297,095 B1.

Re claim 1, Muralidhar discloses a method of forming a nitride barrier layer, comprising the steps of: exposing a dielectric layer 14/102 to a silicon-containing gas under low partial pressure to deposit a continuous layer of silicon 15/16/17/18/19/21/103/104 thereon (figs. 6-10, 21-22, col. 10, lines 25-65; note: in this case, the continuous layer is comprised of a plurality of uniform nanoclusters that were formed across the surface of the tunnel dielectric layer 14/102; further in this regard, *each of the nanoclusters can also be considered as a continuous layer*); and exposing the silicon layer to a nitrogen-containing gas to form a silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details.

Re claim 2, wherein the dielectric layer is exposed to the silicon-containing gas at a partial pressure of about 10^{-2} Torr or less (col. 11, lines 37-50).

Re claim 3, wherein the dielectric layer is exposed to the silicon-containing gas at a partial pressure of about 10^{-2} to about 10^{-7} Torr (col. 11, lines 37-50).

Re claim 4, wherein the dielectric layer is exposed to the silicon-containing gas at a temperature of about $500^{O}C$ to about $700^{O}C$ (col. 10, lines 35-58).

Re claim 5, a method of forming a nitride barrier layer, comprising the steps of: irradiating a dielectric layer 14/102 with a silicon-containing gas under low partial pressure to nucleate the dielectric layer with a uniform layer of silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65; note: in this case, the uniform layer is comprised of a plurality of uniform nanoclusters that were formed across the surface of the tunnel dielectric layer 14/102); and exposing the silicon layer to a nitrogen-containing gas to form a silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details.

Re claim 7, a method of forming a nitride barrier layer, comprising the steps of: exposing a dielectric layer 14/102 to a silicon-containing gas under low partial pressure to deposit a continuous layer of about l 0 to about 30 angstroms silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65 and col. 12, lines 50-55; i.e., 15 angstroms; note: in this case, the continuous layer is comprised of a plurality of uniform nanoclusters that were formed across the surface of the tunnel dielectric layer 14/102; further in this regard, each of the nanoclusters can also be considered as a continuous layer) thereon; and nitridizing the silicon layer in a nitrogen-containing gas to form a silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the

diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details.

Re claim 8, a method of forming a nitride barrier layer, comprising the steps of: exposing a surface of a dielectric layer 14/102 to a silicon-containing gas at a low partial pressure to nucleate the surface of the dielectric layer with a continuous layer of silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65; note: in this case, the continuous layer is comprised of a plurality of uniform nanoclusters that were formed across the surface of the tunnel dielectric layer 14/102; further in this regard, each of the nanoclusters can also be considered as a continuous layer); and exposing the silicon layer to a nitrogen-containing gas to form a silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details.

Re claim 9, a method of forming a nitride barrier layer, comprising the steps of: exposing a dielectric layer 14/102 to a silicon-containing gas at a partial pressure of about 10^{-2} Torr or less (col. 11, lines 37-50) to deposit a continuous layer of about 10 to about 30 angstroms silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65 and col. 12, lines 50-55; i.e., 15 angstroms; note: in this case, the continuous layer is comprised of a plurality of uniform nanoclusters that were formed across the surface of the tunnel dielectric layer 14/102; further in this regard, each of the nanoclusters can also be considered as a continuous layer) thereon; and nitridizing the silicon layer to form a silicon nitride barrier layer 106/107 (figs. 23-25; col. 16,

lines 19-36) having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details.

Re claim 10, wherein the dielectric layer is exposed to the silicon-containing gas at a temperature of about $500^{O}C$ to about $700^{O}C$ (col. 10, lines 35-58).

Re claim 11, wherein the silicon-containing gas is selected from the group consisting of dichlorosilane, silicon tetrachloride, silane, and disilane (col. 10, lines 25-35).

Re claim 12, wherein the step of exposing the dielectric layer to the silicon-containing gas is by plasma enhanced chemical vapor deposition, low pressure chemical vapor deposition, or rapid thermal chemical vapor deposition (col. 10, lines 14-58).

Re claim 13, wherein the silicon-containing gas is deposited by rapid thermal chemical vapor deposition (col. 5, lines 47-67) at about $500^{O}C$. to about $700^{O}C$ (i.e., $600\ ^{O}C$, col. 10, lines 14-58)..

Re claim 14, wherein the dielectric layer comprises silicon dioxide (col. 7, lines 49-55).

Re claim l 6, a method of forming a nitride barrier layer, comprising the steps of: exposing a dielectric layer to a silicon-containing gas at a partial pressure of about 10^{-2} to about 10^{-7} Torr (i.e., 10^{-2} Torr, col. 11, lines 37-50) to nucleate the dielectric layer 14/102 with a continuous layer of silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65; note: in this case, the continuous layer is comprised of a plurality of uniform nanoclusters that were formed across the surface of the tunnel dielectric layer 14/102; further in this regard, each of the nanoclusters can also be considered as a continuous layer); and exposing the silicon layer

to a nitrogen-containing gas to form a silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details.

Re claim 17, a method of forming a nitride barrier layer, comprising the steps of: exposing a dielectric layer 14/102 o a silicon-containing gas at a partial pressure of about 10^{-2} to about 10^{-7} Torr (i.e., 10^{-2} Torr, col. 11, lines 37-50), a temperature of about 500^{O}C. to about 700^{O}C. (i.e., 600 ^{O}C , col. 10, lines 35-58) and a duration of about 1 second to about 5 minutes (i.e., 30 seconds, col. 10, lines 35-58), to nucleate the dielectric layer with a continuous layer of silicon 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65; note: in this case, the continuous layer is comprised of a plurality of uniform nanoclusters that were formed across the surface of the tunnel dielectric layer 14/102; further in this regard, each of the nanoclusters can also be considered as a continuous layer); and exposing the silicon layer to a nitrogen-containing gas to form a silicon nitride barrier layer 106/107 (figs. 23-25; col. 16, lines 19-36) having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details.

Re claim 18, a method of forming a nitride barrier layer, comprising the steps of: depositing a continuous silicon layer 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65; note: in this case, the continuous layer is comprised of a plurality of uniform nanoclusters

that were formed across the surface of the tunnel dielectric layer 14/102; further in this regard, each of the nanoclusters can also be considered as a continuous layer) onto a dielectric layer 14/102 by exposing the dielectric layer to a silicon-containing gas under low partial pressure; and thermally annealing the silicon layer in a nitrogen-containing gas (figs. 23-25; col. 16, lines 19-36) to form the nitride barrier layer having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details..

Re claim 19, a method of forming a nitride barrier layer, comprising the steps of: depositing a continuous silicon layer 15/16/17/18/19/21/103/104 (figs. 6-10, 21-22, col. 10, lines 25-65; note: in this case, the continuous layer is comprised of a plurality of uniform nanoclusters that were formed across the surface of the tunnel dielectric layer 14/102; further in this regard, each of the nanoclusters can also be considered as a continuous layer) onto a dielectric layer 14/102 by exposing the dielectric layer to a silicon-containing gas under low partial pressure, and exposing the silicon layer to a nitrogen-containing gas at a temperature of about 700^{O}C. to about 900^{O}C. to nitridize the silicon layer (figs. 23-25; col. 16, lines 19-36) to form the nitride barrier layer having a thickness of about 7 angstroms (the diameter of the nanocrystal is about 70 angstroms, see col. 12, lines 50-55; and the thickness of the silicon nitride barrier layer is about 10% of the diameter of the nanoclusters, see col. 16, lines 45-55, which is 7 (70X0.1=7 angstroms) angstroms, see figs. 1-28 and cols. 1-22 for more details.

Re claim 97, wherein the silicon on the dielectric layer has a thickness of up to about 30 angstroms (i.e., 30 angstroms, col. 12, lines 50-55).

Re claim 98, wherein the silicon-containing gas is selected from the group consisting of dichlorosilane, silicon tetrachloride, silane, and disilane (i.e., silane; col. 10, lines 25-35).

Re claim 99, wherein the step of exposing the dielectric layer to the silicon gas comprises chemical vapor deposition of the silicon gas (col. 10, lines 14-58).

Re claim 100, wherein the step of exposing the dielectric layer to the silicon gas comprises rapid thermal chemical vapor deposition of the silicon gas (col. 5, lines 47-67 and col. 10, lines 14-58).

Re claim 103, wherein the step of exposing the silicon layer comprises thermally annealing the silicon layer in a nitrogen-containing gas (col. 16, lines 19-37).

Re claim 104, wherein the step of exposing the silicon layer comprises a temperature of about 700^{O}C. to about 900^{O}C (col. 16, lines 19-37).

Re claim 106, wherein the nitrogen-containing gas is selected from the group consisting of nitrogen, ammonia, nitrogen trifluoride, nitrogen oxide, and a nitrogen-helium mixture (col. 16, lines 19-37).

Re claim 112, wherein the step of exposing the dielectric layer comprises a partial pressure of about 10^{-2} to about 10^{-7} Torr (i.e., 10^{-2} Torr, col. 11, lines 37-50), a temperature of about 500^{O}C. to about 700^{O}C. (i.e., 600 ^{O}C , col. 10, lines 35-58) and a duration of about 1 second to about 5 minutes (i.e., 30 seconds, col. 10, lines 35-58).

With respect to claims 1, 5-9 and 16-20, regarding the thickness of the silicon nitride layer, although the exact claimed thickness of about 10 angstroms is not recited in the prior art (Muralidhar et al., U.S./6,297,095 B1). But it appears that the thickness of about 7 angstroms that disclosed by Muralidhar et al., is closed to about 10 angstroms. Therefore, these claims

appear to be *Prima Facie* obvious over Muralidhar et al. Furthermore, the specification contains no disclosure of either the critical nature of the claimed thickness or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitations are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990). Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Muralidhar et al. by selecting the suitable thicknesses for the nitride layer, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. In re Aller, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Re claims 20-21 and 105, Muralidhar disclosed above; however, Muralidhar is silent to the flow rate and duration of the nitrogen-containing gas as required in claims 20-21 and 105. The claimed ranges of flow rate and time/duration, absent evidence of disclosure of criticality for the range giving unexpected results are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955), the selection of reaction parameters such as flow rage, time/duration would have been obvious. *See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

Therefore, the subject matter as a whole would have been obvious to one having ordinary skill in the art at the time the invention was made to select any suitable flow rate and exposing time in the method of Muralidhar in order to nitridize the silicon layer. Furthermore, the specification contains no disclosure of either the critical nature of the claimed process (i.e. the flow rate of 100-10000 sccm for about 1 second to about 180 minutes) or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen limitations or upon another variable recited in a claim, the Applicant must show that the chosen limitations are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack Chen whose telephone number is (571)272-1689. The examiner can normally be reached on Monday-Friday (9:00am-6:30pm) alternate Monday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead can be reached on (571)272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Jack Chen
Primary Examiner
Art Unit 2813

October 29, 2006